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Otolaryngology manifestations of COVID-19 in pediatric patients

Leen O. Hijazi^{*}, Abdulaziz K. Alaraifi, Fahad Alsaab

Division of Otolaryngology-Head and Neck Surgery, Department of Surgery, Ministry of National Guard Health Affairs, King Abdullah International Medical Research Center, Riyadh, Saudi Arabia

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ABSTRACT

Background: The coronavirus disease 2019 pandemic has affected millions of people since its outbreak in December 2019. Limited data exist on otolaryngology manifestations of COVID-19 in pediatrics. This study aims to discuss the clinical features of COVID-19 in pediatrics, with an emphasis on otolaryngology manifestations. **Methods:** The study included 660 COVID-19 laboratory-confirmed positive pediatric patients (aged 3–15 years) diagnosed at King Abdullah Specialist Children Hospital, Riyadh, Saudi Arabia. Data were retrospectively retrieved from January to July 2020 from electronic medical records and included patients' epidemiological and clinical features. Patients were then followed-up via phone calls to document any symptoms encountered after the first visit. Patients were categorized into three main groups according to age (3–6 years, 7–10 years, 11–15 years).

Results: Nearly half of the patients (43.6%) had asymptomatic infections. Fever and cough were the most commonly reported manifestations accounting for 39.2% and 19.8%, respectively. The most frequently reported otolaryngology symptoms were sore throat (17.3%) and rhinorrhea (14.4%). Moreover, 10.4% and 13.1% of children aged 7–15 years old experienced smell and taste disturbances, respectively. Older children (11–15 years) were more likely to report taste disturbances when compared to the younger children (17.2% vs 9.8%, p-value 0.02). Children aged between 3 and 6 years had significantly higher rates of admission (13.7%) and mortality (0.9%) when compared to the older groups (p-value 0.00).

Conclusion: COVID-19 in pediatrics has a milder disease course and a better prognosis than adults. Multiple otolaryngology symptoms were reported in pediatric patients with COVID-19, which can help identify the suspected cases before the test result.

1. Introduction

A novel member of human RNA coronavirus was identified in Wuhan, China in December 2019 [1]. Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [2]. On March 11, 2020, the virus was declared a global pandemic by the World Health Organization (WHO) [2]. There has been a total of 86,436,449 confirmed cases with 1,884,341 fatalities reported in 222 different countries as of January 8, 2021 [3]. Compared to the other SARS-related coronaviruses, SARS-CoV and Middle East respiratory syndrome (MERS), COVID-19 has a significantly lower mortality rate of 2% [4]. However, SARS-CoV-2 is highly contagious and transmissible from human to human by aerosol droplets and contact [4].

The presentation of coronavirus infection ranges from mild to critical, with more than 80% of the infected patients having mild symptoms

only [5]. The symptoms of COVID-19 are variable, including constitutional (e.g., fever and headache), pulmonary (e.g., cough and dyspnea), gastrointestinal (e.g., vomiting and diarrhea), and upper respiratory tract symptoms (sore throat and nasal congestion) [6,7]. The diagnosis of pediatric COVID-19 is a challenge as children cannot describe their health status or contact history. Thus, a high index of suspicion for SARS-CoV-2 infection is required in children [7]. Moreover, the nasal and oropharyngeal swabs have low sensitivity (60–70%) in detecting COVID-19, which increases the importance of reporting the presenting symptoms of COVID-19 [8]. Reporting these symptoms can help identify the suspected cases and isolate them despite the test result.

The available data on otolaryngology-related clinical features of COVID-19 in pediatric patients is limited. Therefore, the purpose of this study is to discuss the clinical features of COVID-19 in pediatric patients, with an emphasis on otolaryngology-related clinical features. Facing this

^{*} Corresponding author. Division of Otolaryngology-Head and Neck Surgery, Department of Surgery, Ministry of National Guard-Health Affairs (NGHA), Riyadh, 11426, Saudi Arabia.

E-mail address: Leenhijazi96@gmail.com (L.O. Hijazi).

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unknown and emerging pathogen, such findings are urgently needed for prevention and treatment of COVID-19 in children.

2. Methods

2.1. Study design and subjects

This is a retrospective study that was conducted at King Abdullah Specialist Children Hospital (KASCH) from January 2020 to July 2020 in Riyadh, Kingdom of Saudi Arabia (KSA). KASCH is a pediatric tertiary hospital that belongs to the governmental sector. All COVID-19 pediatric patients (age 3–15 years old) were enrolled in the study. The diagnosis of COVID-19 was confirmed by performing real-time reverse transcriptase-polymerase chain reaction (RT-PCR) test on both nasopharyngeal oropharyngeal swabs.

2.2. Data collection

A detailed flowsheet containing information on clinical and demographic characteristics (i.e., age and gender), presenting symptoms, and otolaryngology-related clinical features was used to extract data from health care information system (BESTCare database). Also, all patients were contacted via phone 20–40 days after the diagnosis of COVID-19 to document any symptoms encountered after the first visit that were not documented in their electronic records.

2.3. Statistical analysis

The data was entered using Microsoft excel and then analyzed using Statistical Package for the Social Sciences (SPSS®) version 25. Categorical data were summarized and reported as proportions while continuous variables were summarized and reported as means and standard deviations (SDs). Patients were categorized into 3 main groups according to age where one group included ages between 3 and 6 years, one included ages from 7 to 10 years, and the last one comprised ages from 11 to 15 years. The differences between the study groups regarding the clinical manifestations and the course of the disease were compared using chi-square test. A p-value of <0.05 was considered as statistically significant.

2.4. Ethics and permissions

The study was approved by the institutional review board (IRB) at King Abdullah International Medical Research Centre (KAIMRC; study number: RC20/439/R).

3. Results

A total of 660 COVID-19 confirmed cases were enrolled in the study. The gender ratio of female to male was almost equal (49.8%, 50.2%) with a mean age of 8.42 years. Regarding the course of the disease, 628 (95.2%) patients were treated conservatively, 29 (4.4%) patients required admission, and only 2 (0.3%) patients passed away. As shown

Table 1
Epidemiologic Characteristics of COVID-19 patients (N = 660).

Age mean (+/- SD)	8.42 (3.02)
Age groups no (%)	
3–6 yr	211 (32.0%)
7–10 yr	245 (37.1%)
11–15 yr	204 (30.9%)
Sex no (%)	
Male	331 (50.2%)
Female	329 (49.8%)
Diagnosis no (%)	
Asymptomatic infection	288 (43.6%)
Symptomatic	372 (56.4%)

in (Table 1), 288 (43.6%) patients reported no symptoms, while 372 (56.4%) were symptomatic. Fever and cough were the most commonly reported manifestations accounting for 39.2% and 19.8%, respectively. On the other hand, the most common otolaryngology-related clinical features reported in our study were sore throat (17.3%) and rhinorrhea (14.4%).

Table 2 summarizes the reported otolaryngology and non-otolaryngology manifestations into the three age groups. Fever and cough were the two most frequently reported symptoms in all age groups. The most commonly reported otolaryngology-related symptoms were rhinorrhea and sore throat in all age groups as well. The prevalence of taste disturbances was significantly higher in the older age group (11–15 years old) in comparison to children aged from 7 to 10 years, with a prevalence of 17.2% and 9.8%, respectively (p-value 0.02). Headache was significantly (p-value 0.001) less reported in the youngest age group (7.6%) when compared to children aged between 7 and 10 years (16.3%) and children aged from 11 to 15 years (19.6%). On the other hand, the youngest age group had a higher prevalence of vomiting (10.4%) when compared to the other groups with a significant p-value (0.01). Moreover, the youngest age group (3–6 years old) has significantly higher rates of admission (13.7%) and mortality (0.9%) when compared to the older groups, which had neither hospital admissions nor deaths (p-value 0.00), as demonstrated in (Table 2).

Sub-analysis of COVID-19 admitted patients is summarized in (Table 3). The mean age of the 29 admitted patients was 4 years, where none of them required intubation and only one patient was admitted to the Pediatric Intensive Care Unit (PICU). Most of our admitted patients

Table 2
Incidence of otolaryngology and non-otolaryngology manifestations in COVID-19 patients.

Otolaryngology Manifestations, n (%)					
	3–6 years	7–10 years	11–15 years	Overall	p-value
Sore throat	33 (15.6%)	42 (17.1%)	39 (19.1%)	114 (17.3%)	0.64
Rhinorrhea	33 (15.6%)	77 (11.0%)	35 (17.2%)	95 (14.4%)	0.15
Changes in taste		24 (9.8%)	35 (17.2%)	59 (13.1%)	0.02
Changes in smell		22 (9.0%)	24 (11.8%)	46 (10.4%)	0.26
Nasal obstruction	15 (7.1%)	18 (7.3%)	13 (6.4%)	46 (7.0%)	0.92
Ear pain	1 (0.5%)	6 (2.4%)	5 (2.5%)	12 (1.8%)	0.21
Ear fullness	1 (0.5%)	1 (0.4%)	1 (0.5%)	3 (0.5%)	0.99
Non-Otolaryngology Manifestations, n (%)					
	3–6 years	7–10 years	11–15 years	Overall	p-value
Fever	82 (38.9%)	99 (40.4%)	78 (38.2%)	259 (39.2%)	0.89
Cough	37 (17.5%)	42 (17.1%)	52 (25.5%)	131 (19.8%)	0.05
Headache	16 (7.6%)	40 (16.3%)	40 (19.6%)	96 (14.5%)	0.00
Diarrhea	24 (11.4%)	21 (8.6%)	23 (11.3%)	68 (10.3%)	0.53
SOB	10 (4.7%)	17 (6.9%)	15 (7.4%)	42 (6.4%)	0.50
Vomiting	22 (10.4%)	10 (4.1%)	8 (3.9%)	40 (6.1%)	0.01
Course, n (%)					
	3–6 years	7–10 years	11–15 years	Overall	p-value
Conservative	180 (85.3%)	245 (100.0%)	203 (100.0%)	628 (95.2%)	0.00
Admission	29 (13.7%)	0 (0.0%)	0 (0.0%)	29 (4.4%)	
Death	2 (0.9%)	0 (0.0%)	0 (0.0%)	2 (0.3%)	

Table 3

Sub-analysis of COVID 19 pediatric patients requiring admission, N = 29.

Age, mean	4 years
Intubation, n (%)	0 (0%)
Pediatric intensive care unit admission, n (%)	1 (3.5%)
Hospital length of stay, mean	4.8 days
Comorbidities: n (%)	
None	18 (62.1%)
Cardiac diseases	3 (10.3%)
Rheumatological diseases	3 (10.3%)
Hematological diseases	3 (10.3%)
Metabolic diseases	1 (3.5%)
Syndromic	1 (3.5%)

did not have underlying comorbidities (62.1%). The rest had either cardiac diseases (10.3%), rheumatological diseases (10.3%), hematological diseases (10.3%), or metabolic diseases (3.5%). Only one of our admitted patients had Down syndrome (3.5%).

Smell and taste disturbances were classified as either complete loss, partial loss, or no loss and were compared across children aged between 7 to 10 years and 11–15 years, as demonstrated in (Table 4). A complete loss of taste sensation was significantly (p-value 0.03) more reported in the older group (11–15 years old) in comparison to the younger group (7–10 years old) with the prevalence of 8.8% and 3.3%, respectively. There was no significant difference in the prevalence of smell disturbances between the two groups.

4. Discussion

In contrast to the previous coronavirus outbreaks experienced in the past two decades, SARS-CoV-2 has a significant impact on pediatric public health. SARS and MERS did not widely influence the pediatric population due to the short-term epidemic of the former and the strict transmission route of the latter [1]. The most common presenting symptoms of coronavirus infection are non-specific, including fever, headache, malaise, cough, and sore throat [6,7]. Lower respiratory tract involvement can lead to pneumonia and progress rapidly to acute respiratory distress syndrome (ARDS) and even death [6]. Our study showed that the most common clinical features of COVID-19 in pediatrics are fever and cough reported in 39.2% and 19.8%, respectively. Fever may not always present in children despite its high prevalence; some may only exhibit cough, gastrointestinal or upper respiratory symptoms, or no symptoms at all [7]. Among the pediatric patients in our study, 43.6% were asymptomatic. It is crucial to note that the percentage of asymptomatic children is higher than that of adults, which reported to range between 17% and 20% [9]. This issue makes the diagnosis and control of COVID-19 more challenging as children can act as silent carriers and spreaders [10].

The involvement of the upper respiratory tract can manifest in several otolaryngology-related manifestations, including sore throat, nasal congestion, rhinorrhea, as well as taste and smell disturbances [11]. These symptoms were reported to be the only presenting

symptoms in patients with positive COVID-19 tests in several studies [6, 11,12]. The most frequently reported otolaryngology symptoms in our study were sore throat, followed by rhinorrhea, taste and smell disturbances, and nasal obstruction (ranging between 10.4% and 17.3%). The only otologic symptoms reported in our study were otalgia and ear fullness in 1.8% and 0.5%, respectively.

Olfactory and gustatory dysfunctions are common manifestations in COVID-19 patients [13]. Kaye et al. showed that anosmia was reported in 73% of adults prior to the laboratory diagnosis of COVID-19, and it was the presenting symptom in 26.6% of all cases [14]. A meta-analysis of the data from Tong et al. showed a prevalence of olfactory and gustatory dysfunctions in infected adults of 52.7% and 43.93%, respectively [13]. However, a lower prevalence has been detected in children as described by Concheiro-Guisan et al., which showed that 15% of infected children, aged 11 and older, reported having anosmia [15]. In our study, 10.4% and 13.1% of children aged 7–15 years old experienced smell and taste disturbances, respectively. The older group in our study reported having taste disturbances significantly more frequently than the group including children between 7 and 10 years of age, with the prevalence of 17.2% and 9.8%, respectively. The lower rates of olfactory and gustatory dysfunctions in pediatrics might be explained by the milder disease course as well as the receptor immaturity [15]. Studies showed that the sustentacular cells of the olfactory epithelium, which are suggested to have a role in virus entry, are increasing in number as age increases in animal models [16]. In our study, the smell and taste disturbances were only reported in patients who are older than six years, as it was demonstrated in the literature that patients younger than this age group are unreliable in detecting gustatory and olfactory disturbances [17,18].

Several hypotheses were reported aiming to explain the mechanism of the impairment of olfaction and gustation in COVID-19. ACE2 (angiotensin-converting enzyme 2) is highly expressed on a variety of olfactory epithelial cell types and mucous membrane, particularly the tongue, raising the possibility that the COVID 19 invasion of these cells may lead to anosmia and ageusia [1]. The virus may carry out its damage to the level of the olfactory bulb rather than only the epithelial cells [14]. Another possibility is that anosmia may occur due to a conductive impairment with or without a sensorineural impairment. Nasal congestion or edema of the nasal respiratory epithelium can prevent the odorants from reaching the olfactory cleft [1].

Several other symptoms were reported in our study, such as headache, dyspnea, diarrhea, and vomiting (ranging between 6.1% and 14.5%). Our data showed that younger children (3–6 years old) were significantly more likely to experience vomiting (10.4%) while older children (7 years or older) had a significantly higher rate of headache (16.3–19.6%) in comparison to patients aged 3–6 years (7.6%). In general, headache is a common symptom in most respiratory viruses [19]. The exact mechanism of headache in COVID-19 is under investigation. It might be due to the exogenous or endogenous pyrogen as well as other immunoinflammatory mediators accompanying the infection [20]. Another possible explanation is the invasion of the central nervous system via the olfactory bulb, which may explain the high prevalence of both headache and smell disturbances in COVID-19 [20].

Pediatric patients tend to develop a milder form of COVID-19 infection in comparison to adults with faster recovery and better prognosis [2]. Only a minority of COVID-19 positive children require admission to the hospital. In a study conducted in the United States, the estimated rate of hospitalization ranged from 6% to 20% [15]. Only 4.4% of the pediatric patients in our study required hospitalization, all of whom were between 3 and 6 years old. Prognostic factors for severity of COVID-19 in pediatrics are not yet fully understood. Most our hospitalized patients reported to be previously healthy with no underlying conditions (62.1%). Of our admitted patients, 37.9% had previous conditions which included valvular diseases, Kawasaki, Acute Lymphocytic Leukemia (ALL), isovaleric academia, and Down syndrome. Adult patients with COVID-19 in epidemic areas, such as Wuhan, have

Table 4

Change in smell and taste in COVID-19 pediatric patients.

Change in smell			
	7–10 years	11–15 years	P-value
Complete	7 (2.9%)	14 (6.9%)	0.12
Partial	15 (6.1%)	10 (4.9%)	
None	223 (91.0%)	180 (88.2%)	
Change in taste			
	7-10 years	11-15 years	P-value
Complete	8 (3.3%)	18 (8.8%)	0.03
Partial	16 (6.5%)	17 (8.3%)	
None	221 (90.2%)	169 (82.8%)	

high mortality rates (>4%) [1]. In contrast, the reported mortality rate in the literature of children with COVID-19 infection is extremely low (0.1%) [10]. In our study, only two patients (0.3%) passed away while infected by COVID-19, both of them were in the group including children 3–6 years of age, with cardiac arrest being the reason for death. Suggested reasons for these low morbidity and mortality rates in the pediatric population include that children rarely have any underlying diseases and have a more active innate immune system [21]. Another hypothesis suggests that smoking, which is less prevalent in children, enhances the expression of human angiotensin-converting enzyme 2 (the primary entry receptor for COVID-19) [10].

The present study has a few limitations. These include collecting the data from only one hospital, which may limit the generalizability of the study. Another drawback of the present study is the lack of an objective assessment due to the infection control precautions. Also, because this study included retrospective self-reported information, it may be prone to recall bias. On the other hand, this study is one of only a few that discussed otolaryngology manifestations in pediatric patients with COVID-19 in a large sample. Moreover, this is the first study to examine the otolaryngology manifestations in pediatric patients with COVID-19 in KSA.

5. Conclusion

Pediatric COVID-19 patients have a milder disease course, a higher rate of asymptomatic infections, and lower mortality and hospital admission rates. Sore throat, nasal congestion, and rhinorrhea are the most frequently reported otolaryngology symptoms in our study. The prevalence of taste disturbances increases as age increases. Reporting these symptoms can help identify the suspected cases and isolate them before the test result.

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The authors indicate no significant interest with commercial supporters.

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